DOCUMENT RESUME

ED 384 608 SP 036 110

AUTHOR Pajares, Frank
TITLE Self-Efficacy in Academic Settings.
PUB DATE Apr 95
NOTE 39p.; Paper presented at the Annual Meeting of the American Educational Research Association (San Francisco, CA, April 18-22, 1995).
PUB TYPE Information Analyses (070) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Academic Achievement; Anxiety; Beliefs; *Educational Research; Elementary Secondary Education; Higher Education; Metacognition; Predictive Validity; Self Concept; *Self Efficacy; Self Evaluation (Individuals); Self Management; Self Motivation; *Student Characteristics; *Student Motivation

ABSTRACT

This paper explored the contributions made by self-efficacy theory to the study of self-regulation and motivation in academic settings. Findings on the relationship between self-efficacy and academic performance are first summarized. The conceptual difference between the definition and use of perceptions of competence in social cognitive theory and in other theoretical perspectives of motivation is clarified. Next, results of recent studies that investigated the role of self-efficacy and other motivational constructs in various academic areas are reported. Overall results demonstrated that, when self-efficacy is included in statistical models with other, more global, self-beliefs (such as self-concept, anxiety, and attributions), and with variables such as academic background, gender, ethnicity, ability, and socioeconomic status, self-efficacy is a strong predictor of academic performance and mediates the influence of other determinants. (Contains 104 references.) (PB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

Running Head: SELF-EFFICACY

SELF-EFFICACY IN ACADEMIC SETTINGS

Frank Pajares
Emory University

ED 384 608

Paper presented at a symposium held during the meeting of the American Educational Research Association, San Francisco, 1995.
Session 39.10

PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

F. Pajares

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

Please address correspondence to:

Frank Pajares
Educational Studies
Emory University
Atlanta, GA 30322

Tel: 404-727-1775
Fax: 404-727-2799
Email: Mpajare@unix.cc.emory.edu

BEST COPY AVAILABLE

SP036110

Self-Efficacy in Academic Settings

Abstract

The purpose of this paper was to identify the unique contribution made by self-efficacy theory to the study of self-regulation and motivation in academic settings. Findings on the relationship between self-efficacy and academic performances are first summarized. Second, the conceptual difference between the definition and use of perceptions of competence in social cognitive theory and in other theoretical perspectives of motivation is clarified. Last, results of recent studies that investigate the role of self-efficacy and other motivational constructs in various academic areas are reported. These results demonstrate that, when self-efficacy is included in statistical models with other, more global, self beliefs (e.g., self-concept, anxiety, perceived usefulness, attributions) and with variables such as academic background, gender, race\ethnicity, ability, and socioeconomic status, self-efficacy is a strong predictor of academic performance and mediates the influence of other determinants. These results support A. Bandura's (1986) contention that particularized measures of self-referent thought surpass global measures in the explanation and prediction of related outcomes.

Self-Efficacy in Academic Settings

In *Social Foundations of Thought and Action*, Albert Bandura (1986) wrote that individuals possess a self system that enables them to exercise a measure of control over their thoughts, feelings, and actions. This self system includes the abilities to symbolize, learn from others, plan alternative strategies, regulate one's own behavior, and engage in self- reflection. Human behavior results from the interplay between this self system and external-environmental sources of influence. It is the capability for self-reflection, however, that is most uniquely human, for this form of self-referent thought allows people to evaluate and alter their own thinking and behavior. These self-evaluations include perceptions of self-efficacy--personal judgments of capability to accomplish specific tasks and deal with different realities.

Perceptions of efficacy influence human behavior in three ways. First, they influence choice of behavior. People engage in tasks in which they feel competent and confident and avoid those in which they do not. Second, they help determine how much effort people will expend on an activity and how long they will persevere--the higher the sense of efficacy, the greater the effort expenditure and persistence. Finally, self-efficacy beliefs influence individuals' thought patterns and emotional reactions. People with low self-efficacy may believe that things are tougher than they really are, a belief that fosters stress and a narrow vision of how best to solve a problem. High self-efficacy, on the other hand, creates feelings of serenity in approaching difficult tasks.

Self-efficacy beliefs are important influences on motivation and behavior in part because they *mediate* the relationship between knowledge and action. That is, environmental, cognitive, and affective factors influence behavior partly by influencing self beliefs. As such, these beliefs are strong predictors of individuals' subsequent performances. The tenets of self-efficacy theory, as that specific area of social cognitive theory has come to be called, have been tested in varied disciplines and settings and have received support from a growing body of findings from diverse fields (see Bandura, in press; Lent & Hackett, 1987; Maddux & Stanley, 1986; Multon, Brown, & Lent, 1991; Schunk, 1991).

In educational settings, self-efficacy has been prominent in studies that have explored its relationship with attributions (Schunk, 1981, 1982a; Schunk & Cox, 1986; Schunk & Gunn, 1986), career development (see Lent & Hackett, 1987, for a review), goal setting (Bandura & Schunk, 1981; Schunk, 1983a; Wood & Bandura, 1989), memory (Berry, 1987), modeling (Schunk, 1981, 1987; Schunk & Hanson, 1985, 1988; Zimmerman & Ringle, 1981), problem solving (Larson, Piersel, Imao, & Allen, 1990), reward contingencies (Schunk, 1983b), self-regulation (Schunk, 1982b), social comparisons (Bandura & Jourden, 1991; Schunk, 1983a), strategy training (Schunk & Cox, 1986), teaching and teacher education (Ashton & Webb, 1986), anxiety and self-concept (Pajares & Miller, 1994a, 1994b), and academic performances across subject areas (Bandura, 1993; Zimmerman & Bandura, 1994). In general, researchers have established that self-efficacy beliefs are correlated with other self beliefs and with academic changes and outcomes and that self-efficacy is a strong predictor of related academic outcomes.

The role that self beliefs play in motivating individuals is the primary focus of theoretical perspectives other than social cognitive theory. These include theories about self-concept, attributions of success and failure, expectancy-value, goals, and self-schemas. In the quest for predictive supremacy and practical utility, self beliefs are also in competition with variables that have been identified as influencing students' academic outcomes, such as anxiety, perceived usefulness, previous experience and achievement, aptitude and ability, gender, race/ethnicity, and socioeconomic status.

To better understand the role these self beliefs play in academic settings, researchers have investigated the relationship between these beliefs and various academic outcomes as well as that among the beliefs themselves. Although results have generally supported the contentions of social cognitive theory as regards the role of self-efficacy, they have not been as successful in clarifying the nature of the relationship between self-efficacy beliefs and motivational constructs from other theoretical perspectives. There are several reasons for this. Perhaps the major one is that researchers from theoretical camps other than social cognitive theory have tended to define judgments of capability in ways consistent with their own conceptualization of such self-perceptions but not consistent with its definition and use by self-efficacy researchers. In most

cases, such definitions have been global and general and have lacked the *specificity* and *consistency with the criterial task* that optimizes the predictive power of self-efficacy beliefs. As a consequence, results tend to minimize the influence of self-efficacy and maximize the influence of the determinants of interest to the theory in question. In studies utilizing causal modeling, the theoretical frameworks used to hypothesize relationships have quite naturally been based on the perspectives of the researchers, and so results add little to the understanding of self-efficacy's presumed influence. As Gilligan (1982) observed, theory has the tendency to blind observation.

The purpose of this paper is to identify the unique contribution made by self-efficacy theory to the study of self-regulation and motivation in academic settings and to compare its influence on academic performances with that of other self beliefs prominent in theories of motivation. To these ends, findings on the relationship between self-efficacy and academic performances are first briefly summarized. Second, the conceptual difference between the definition and use of perceptions of competence in social cognitive theory and in other theoretical perspectives of motivation is clarified. Last, recent findings that assess the role of self-efficacy percepts and other motivational constructs in various academic areas are presented.

Self-efficacy and Academic Performance

Since publication of a seminal article introducing the construct of self-efficacy in 1977, Bandura (1978, 1982, 1984, 1986, 1989, 1991, 1993, 1995, in press) has consistently maintained that the judgments of capability an individual brings to a specific task are strong predictors of the performance that results from that task and mediate the influence of other determinants of that performance. The growing number of researchers who have subsequently investigated the role of self-efficacy in academic settings generally support these contentions (e.g., Bores-Rangel, Church, Szendre, & Reeves, 1990; Bouffard-Bouchard, 1989; Brown, Lent, & Larkin, 1989; Felson, 1984; Lent, Brown, & Larkin, 1984, 1986; Locke, Frederick, Lee, & Bobko, 1984; Maddux, Norton, & Stoltenberg, 1986; McCarthy, Meier, & Rinderer, 1985; Meier, McCarthy, & Schmeck, 1984; Pajares & Johnson, 1994; Pajares & Kranzler, 1994; Pajares & Miller, 1994a, 1994b, 1995; Shell, Murphy, & Bruning, 1989; Vollmer, 1986; Wood & Locke, 1987; and see Schunk and his colleagues; Lent & Hackett, 1987, for review of research on career self-efficacy).

Despite this abundance of riches, however, many studies are plagued by assessments of self-efficacy that do not follow Bandura's (1986) guidelines regarding specificity and consistency with criterial tasks. Bandura cautioned that, because judgments of self-efficacy are task- and domain-specific, global or inappropriately defined self-efficacy assessments will weaken effects. When the efficacy beliefs assessed do not reflect with specificity the criterial task with which they are compared, their predictive value is diminished. For this reason, measures of self-efficacy should be tailored to the criterial task being assessed and the domain of functioning being analyzed. This caution has often gone unheeded in educational research, where assessments of self-efficacy frequently bear little resemblance to the criterial task with which they are compared but, instead, reflect generalized, or sometimes even unrelated, attitudes about capabilities. The mismatch between self-efficacy and criterial task assessment is a recurring theme, often producing confounded relationships and ambiguous findings.

Multon et al. (1991) found 36 studies written between 1977 and 1988 on the relationship between self-efficacy and academic performance or persistence that met their criteria for inclusion in a meta-analysis: containing a measure of self-efficacy and academic performance and providing sufficient information to calculate effect size estimates. They computed that efficacy beliefs were related to performance (r_u = .38) and accounted for approximately 14% of the variance in academic performance. However, effect sizes depended on specific characteristics of the studies, notably on the types of efficacy and performance measures used. The strongest effects were obtained by researchers who compared specific efficacy judgments with basic skills measures of performance, developed highly concordant self-efficacy/performance indices, and administered them at the same time. Significant relationships are obtained even with generalized self-efficacy indices, a phenomenon that Multon et al. described as reinforcing the theoretical and practical value of self-efficacy but that also tends to produce confounded and misleading results. In fact, if global and generalized self-efficacy assessments can predict performances that are not specifically related, the relationship between properly assessed self-efficacy and performance should certainly increase.

Not all researchers have found a significant relationship between efficacy beliefs and academic outcomes. Wilhite (1990) found that college students' self-assessment of memory ability was the strongest predictor of academic achievement (GPA), followed by locus of control. Self-efficacy showed a weak relationship. However, efficacy judgments were assessed using a global self-concept measure. Smith, Arnkoff, and Wright (1990) tested the predictive power of three theoretical models on academic performance--cognitive-attentional, cognitive-skills, and social learning. Smith et al. concluded that, although variables within each model predicted performance to some degree, self-efficacy was a weak predictor. Self-efficacy was operationalized as study skills or test-taking ability and was measured with items such as "Rate how certain you are that you can study at a time and place where you won't get distracted." This was compared with academic outcomes such as exam grades and course GPA. Again, when efficacy beliefs do not reflect with specificity the criterial task, predictive power is minimized.

Some researchers have found that self-efficacy is related to self-regulated learning variables (e.g., Feather, 1988; Fincham & Cain, 1986; Paris & Oka, 1986; Pokay & Blumenfeld; 1990; Schunk, 1982b, 1985). Findings in this area suggest that students who believe they are capable of performing certain tasks use more cognitive and metacognitive strategies and persist longer than those who do not (Pintrich & Garcia, 1991). For example, Pintrich and De Groot (1990) reported a correlation between global academic self-efficacy and both cognitive strategy use and self-regulation through use of metacognitive strategies. In addition, academic self-efficacy correlated with academic outcomes such as semester and final year grades, in-class seatwork and homework, exams and quizzes, and essays and reports. Perceived importance of academic achievement was associated with the outcome variables but was not a significant predictor. Pintrich and De Groot concluded that self-efficacy played a mediational or "facilitative" role in relation to cognitive engagement, that improving self-efficacy might lead to increased use of cognitive strategies and, thereby, higher performance, and that "students need to have both the 'will' and the 'skill' to be successful in classrooms" (p. 38).

A growing number of other findings support Bandura's (1986) contention that efficacy beliefs mediate the effect of skills or other self-beliefs on subsequent performance by influencing

effort, persistence, and perseverance. For example, Collins (1982) identified children of low, middle, and high mathematics ability who had, within each ability level, either high or low mathematics self-efficacy. After instruction, the children were given new problems to solve and an opportunity to rework those they missed. Collins reported that ability was related to performance but that, regardless of ability level, children with high self-efficacy completed more problems correctly and reworked more of the ones they missed.

Schunk (1981) used path analysis to show that modeling treatments increased persistence and accuracy on division problems by raising children's self-efficacy, which had a direct effect on skill. He later demonstrated that effort attributional feedback of prior performance (e.g., "You've been working hard") raised the self-efficacy expectations of elementary school children, and this increase was, in part, responsible for increased skill in performance of subtraction problems (Schunk, 1982a). In subsequent experiments, he found that ability feedback (e.g., "You're good at this") had an even stronger effect on self-efficacy and subsequent performance (Schunk, 1983; Schunk & Gunn, 1986). Relich, Debus, and Walker (1986) also reported that self-efficacy mediated the role of skill training and attributional feedback and had a direct effect on the performance of division problems of learned helpless sixth graders. Attribution showed a moderate direct effect on performance and a stronger indirect effect mediated by self-efficacy. Schunk (1991) has provided an overview of research on the effect of self-efficacy beliefs on academic motivation, specifically the role played by variables such as perceived control, outcome expectations, perceived value of outcomes, attributions, and self-concept. He concluded that all may provide a "type of cue" used by individuals to assess their efficacy beliefs.

Self-efficacy and Other Motivational Theories

In some fashion, perceptions of capability play a prominent role in most theories of motivation. For example, self-concept theorists point out that these percepts of self-worth include judgments of confidence (see Rosenberg & Kapland, 1982; Shavelson & Bolus, 1982; Shavelson, Hubner, & Stanton, 1976). Consequently, self-efficacy is considered an important component of an individual's self-concept. Self-schema theory provides a concept of self with

four dimensions, one of which, the *efficacy* dimension, is characterized by individuals' beliefs about their potentialities (Garcia & Pintrich, 1994). In attribution theory (Weiner, 1979), the causal attributions that individuals make about the success or failure of their actions are presumed to influence their subsequent performance expectancies. Recent findings suggest that this relationship is reciprocal and that attributions influence motivation and performance largely through the mediational role of self-efficacy (see Bandura, 1995; Schunk, 1991). And goal theorists concur that self-perceptions of competence provide essential information used by individuals when setting goals (Ames, 1992; Dweck & Leggett, 1988; Nicholls, 1984, 1990). Within the constructs that form the centerpiece of these theories, judgments of personal capability perform the functions that Bandura (1986) suggests.

Subsuming beliefs of personal efficacy under broader and more generalized motivational constructs may be useful for purposes of validating these constructs, but it can be problematic in that it can obfuscate important differences between the self-beliefs and minimize the unique contribution that self-efficacy perceptions make to an understanding of motivation and behavior. To illustrate, it may be useful to explore in some depth the differing conceptions of the role of self-efficacy perceptions in another theoretical perspective, that of expectancy-value theory. According to this perspective, motivation is primarily a result of individuals' beliefs about the likely outcomes of their actions and of the incentive value they place on those outcomes (Atkinson, 1957; MaClelland, 1985). Individuals will be motivated to engage in tasks when they value the outcome expected; they will be less predisposed to perform tasks whose outcomes they do not value.

Expectancy-value theorists agree that judgments of competence play an interactive role with valued outcomes in determining the tasks in which individuals will engage (Eccles, 1983; Wigfield & Eccles, 1992), but they emphasize the more prominent role of a construct similar to that which Bandura (1986) called *outcome expectations* in influencing motivation and predicting behavior. According to Bandura, judgments of personal competence differ from judgments of the likely consequence that behavior will produce. Outcome expectations are related to efficacy beliefs because these beliefs in part determine the expectations. Individuals who expect success

in a particular enterprise anticipate successful outcomes. Students confident in their math skills, for example, expect high marks on related exams and expect the quality of their work to reap benefits. The opposite is also true of those who lack such confidence. Students who doubt their math ability envision a low grade before they begin a math exam. The expected results of these imagined performances will be differently envisioned: academic success and other benefits for the former, academic failure and curtailed possibilities for the latter.

Bandura (1984, 1986) argued that, because the outcomes people expect are largely dependent on their judgments of what they can accomplish, outcome expectations are unlikely to make much of an independent contribution to predictions of behavior when self-efficacy perceptions are controlled. This is not to say that efficacy and outcome judgments are always consistent. A high sense of efficacy may not result in behavior consistent with that belief if an individual also believes that the outcome of engaging in that behavior will have undesired effects. For example, some students may realize that strong math skills are essential for a good score on the Graduate Record Examination (GRE) and eligibility for graduate school, which, in turn, may ensure a prestigious career and affluent lifestyle, but low confidence in math abilities may keep them away from certain courses and they may not bother to take the GRE or apply to graduate school. High self-efficacy and negative outcome expectations are similarly possible.

The distinctions that Bandura (1978) drew between self-efficacy and outcome expectations, as well as the roles he suggested they each play, are not without controversy. Kirsch (1985) argued that Bandura used the term outcome expectations in two different ways. A perceived environmental contingency, Kirsch noted, is an outcome expectation beyond the control of the individual. It is knowledge of logical and immutable consequences, such as knowing that a good score on the GRE results in graduate school admission. These outcome expectations are independent of individuals' perceptions of their own competence. This meaning, Kirsch argued, is at odds with Bandura's claim that "the outcomes one expects derive largely from judgments as to how well one can execute the requisite behavior" (p. 241), for, in this sense, outcomes are dependent on performance and may well be at the mercy of efficacy beliefs.

Some researchers find the distinction between the two constructs ambiguous and suggest that outcome expectations cannot so easily be extricated from efficacy beliefs (Eastman & Marzillier, 1984; Kazdin, 1978; Manning & Wright, 1983; Marzillier & Eastman, 1984; Teasdale, 1978). They contend that self-efficacy judgments are dependent on and inextricably intertwined with perceptions of the outcomes envisioned by actions. Therefore, outcome expectations play a large role in creating efficacy perceptions. To illustrate that Bandura oversimplified the variables involved in behavior change, Marzillier and Eastman (1984) used the example of a socially anxious man who is asked to attend a party. To this poor soul, the perceived outcomes are disastrous--people will notice he looks odd and laugh at him, and he will make a fool of himself, be unable to talk to anyone, and drink too much. Marzillier and Eastman argued that these expectations cannot be disassociated from efficacy judgments, that outcome beliefs are as important in determining whether the man will attend the party as is his belief in whether he can cope with the demands of the occasion. They argued that individuals infer their efficacy beliefs from imagined outcomes. Consistent with the tenets of expectancy-value theory, they suggested that an individual's perception of the outcome and his value of the task necessary to achieve that outcome will regulate his behavior as powerfully as his self-efficacy beliefs, and independent of them.

Bandura (1984) countered that such cart-before-the-horse thinking fails to take into consideration that "one cannot conjure up outcomes without giving thought to what one is doing and how well one is doing it" (p. 232). The man confronted with the decision of whether to attend the party envisions disastrous outcomes largely because he has little confidence in his capabilities to meet the demands associated with parties. Foresightful action requires a causal ordering wherein "human causal thinking places actions before the outcomes that flow from them" (p. 237). It is unlikely that the partyphobic man, when faced with the decision of whether to attend, envisions the disastrous outcomes and concludes that he is an inefficacious partygoer. More likely, the perceived self-inefficacy creates the envisioned outcomes. It is also possible, Bandura argued, to exclude considerations of outcome from judgments of personal efficacy. For example, students are capable of assessing their academic capabilities quite apart from any

outcomes they may envision. Eastman and Marzillier (1984) remained dissatisfied and unconvinced.

As earlier noted, researchers with theoretical persuasions other than those of social cognitive theory define and use judgments of competence in ways consistent with their theoretical understandings but not always with its definition and use by self-efficacy theorists. Quite naturally, they also hypothesize relationships in statistical models from the perspective of their own theoretical framework. As a consequence, the influence of self-perceptions of competence is minimized and that of the competing belief optimized. In spite of these problems, several studies from other theoretical perspectives offer strong support for the hypothesized role of self-efficacy. One such investigation was conducted by Meece, Wigfield, and Eccles (1990), who constructed two structural equation models from the perspective of expectancy-value theory to investigate the relationship among mathematics ability perceptions, performance expectancies, perceived importance, anxiety, and mathematics performance in a two-year longitudinal study of junior high school students. Ability perceptions and performance expectancies were described as "two types of efficacy beliefs" (p. 62). Some of the ability perception items, however, would not be considered self-efficacy judgments by social cognitive theorists (e.g., "How have you been doing in math this year?"), and the performance expectancies were global judgments of the type that work to minimize effects (e.g., "How well do you expect to do in math this year?"). Importance of mathematics was analogous to perceived usefulness (e.g., "Being good at math is important").

Model 1 tested the effects of perceived ability, expectancies, and importance on anxiety, and Model 2 tested the effects of those four variables on students' grade point average (GPA). In both cases, perceived ability was used as an exogenous variable hypothesized to be causally predominant over the others. Perceived expectancies were hypothesized to have a reciprocal relationship with importance in Model 1 and with importance and anxiety in Model 2. Because Meece et al. (1990) conceptualized ability perceptions and performance expectancies as two types of self-efficacy, they used ability perceptions from Year 1 to predict both anxiety and GPA in Year 2 in an effort to avoid potential problems of multicollinearity. Despite the global

assessme[illegible]rrelations with grades were higher for the efficacy items than for the importance or anxiety items, and path analysis results revealed that expectancies (global self-efficacy) had a significant direct effect on grades whereas perceptions of importance did not.

The researchers found that expectancy (globally assessed self-efficacy) and perceived importance were significantly related in both models and noted that Atkinson (1957) had argued the relationship should be inverse--that individuals place greater value on tasks they believe they can least accomplish. Recall that, according to social cognitive theory, the perceived importance of a task is in large part the result of the outcome expectation an individual has for a particular task and is related to self-efficacy judgments in much the same way as are outcome expectations. Bandura (1986) argued that, because beliefs in part determine expectations, people generally value those things they feel capable of accomplishing and do not place as much value on those for which they have little confidence to perform. It is not unusual, then, that expectations and perceived importance should be related, though the relationship can be complex.

Feather (1988) also used an expectancy-value orientation in a path analysis to study the effect of math self-concept, perceived value of mathematics, and gender on the enrollment decisions of university students. Like Meece et al. (1990), Feather defined mathematics self-concept as a reflection of "expectancies of success in mathematics" (p. 381) that "could therefore be classified as self-efficacy expectations" (p. 382) and assessed it with two global items, the first asking students to report their previous mathematics grades (top 10%, well above average, etc.) and the second with the item, "In general, how do you rate your ability to do well at mathematics?" Like Meece et al., Feather also found that perceived ability and importance were correlated. Perceived ability also showed a stronger direct effect on choice of majors than did perceived importance. Recall that what is noteworthy about these two studies is that, although from a differing theoretical orientation, they demonstrate the predictive and mediational role of self-efficacy, even when globally assessed.

Recent Investigations

A recent line of inquiry by Pajares and his colleagues has focused on the predictive and mediational role of self-efficacy in academic settings. One important component of these studies

is the inclusion of other motivational constructs so as to help clarify the interplay among them. In all cases, judgments of self-efficacy are measured in terms of *particularized self-perceptions of competence that are consistent with the criterial task being assessed.* For example, if the criterial task involves solving mathematics problems, the efficacy assessment asks students to provide judgments of confidence to solve the individual problems (e.g., Pajares & Kranzler, 1994; Pajares & Miller, 1994a, 1994b, 1995); if the task involves writing an essay, students are asked to provide judgments that they possess the various composition, grammar, usage, and mechanical skills on which their writing performance is assessed (e.g., Pajares & Johnson, 1994, 1995; Valiante & Pajares, 1995). Results from these studies demonstrate that, when self-efficacy judgments are included in path analyses or multiple regression models with other, more global, self beliefs (e.g., self-concept, anxiety, perceived usefulness, perceptions of self-regulation, attributions) and with variables such as ability and aptitude, academic background, race\ethnicity, gender, and socioeconomic status, self-efficacy is a strong predictor of related academic outcomes and mediates the influence of other determinants of academic performance. These results support Bandura's (1986) contention that particularized measures of self-referent thought surpass global measures in the explanation and prediction of related outcomes.

Math Self-efficacy, Self-concept, Perceived Usefulness, and Anxiety

Pajares and Miller (1994a) used path analytic techniques to discover whether mathematics self-efficacy beliefs play the mediational role ascribed to them by social cognitive theory and whether these beliefs are stronger predictors of solving mathematics problems than are other determinants of performance such as self-concept, anxiety, perceived usefulness, previous experience, and gender. The strong correlation between self-concept and anxiety created a problem of multicollinearity, which creates instabilities in the parameter estimates that lessen the effect of each variable. As a consequence, Pajares and Miller removed anxiety from the path model, a choice guided by their primary interest in the interplay between self-efficacy and self-concept (see Table 1). The independent variables accounted for 52% of the variability in problem-solving performance, $F(6,343) = 61.80$, $p < .0001$.

Pajares and Miller (1994a) found that math self-efficacy had stronger direct effects on problem-solving performance ($\beta = .545$) than did the other determinants (see Figure 1). Math self-concept and high school level each had modest effects. Results also revealed that the relationships between performance and both self-concept and perceived usefulness were largely a result of noncausal covariation due to the effect of self-efficacy. Self-efficacy influenced performance almost exclusively directly and also mediated the effects of gender and prior experience on self-concept, perceived usefulness, and problem-solving performance.

Writing Self-efficacy, Self-concept, and Apprehension

Pajares and Johnson (1995) also used path analysis to investigate the influence of writing self-efficacy, writing self-concept, and writing apprehension on high school students' essay-writing performance, using a model that controlled for the effects of gender and previously assessed writing aptitude. The researchers were especially interested in whether self-efficacy beliefs would make an independent contribution to the prediction of writing performance given the expected powerful effect of the aptitude assessment. Results showed that students' self-efficacy perceptions were strong predictors of their writing performance and played the mediational role hypothesized by social cognitive theory. Self-efficacy had a direct effect on writing apprehension and performance and partially mediated the effect of gender and writing aptitude on apprehension and performance (see Figure 2). The independent variables accounted for 53% of the variability in performance, $F(4, 173) = 47.97$, $p < .0001$. It should also be noted that the use of previous performance and aptitude assessments as controls in studies of self-efficacy is itself problematic, as these are confounded with the influence of the self-efficacy and other beliefs that earlier influenced these prior determinants (Bandura, in press; Dew, Galassi, & Galassi, 1984; Hackett & Betz, 1989). As a consequence, if the prior effect of self-efficacy is not partialed out, the effect of self-efficacy in the model is lessened.

Pajares and Johnson (1995) reported that the magnitude of the correlations between all independent variables and performance, as well as that between these variables and self-efficacy, was generally consistent with those of previous investigations (see Table 2). One exception was the strong relationship between writing self-efficacy and performance (.60), which was higher

than had previously been obtained. This was likely due to the raters' use of the self-efficacy items as the criteria for scoring the essays.

As was the case in Pajares and Miller's (1994a) investigation of math self-efficacy, the strong correlation between self-concept and apprehension resulted in multicollinearity. Due to the prominence of writing apprehension in the writing research literature, the researchers removed writing self-concept from the path model. Although students' writing apprehension and performance were correlated, results showed that the influence of apprehension on performance was largely a result of noncausal covariation with self-efficacy. This finding is consistent with others that have been reported by researchers exploring writing or other academic areas (see Alexander & Martray, 1989; Hackett & Betz, 1989; Meece et al., 1990; Pajares & Kranzler, 1994; Pajares & Miller, 1994a, on mathematics; Meier et al., 1984; Pajares & Johnson, 1994, 1995, on writing). A model in which apprehension was replaced with self-concept was tested and revealed similar results. These findings were replicated by Valiante and Pajares (1995) with a sample of fifth grade students.

Math Self-efficacy, Self-concept, Anxiety, and General Mental Ability

Pajares and Kranzler (1994) constructed a path model that included math self-efficacy, general mental ability, math anxiety, previous background in mathematics, and gender, with relationships hypothesized from prior findings and social cognitive theory (see Table 3). The most substantive effort to extend previous findings involved the inclusion in the path model of a measure of general mental ability, or psychometric *g*. Pajares and Kranzler chose an assessment of psychometric *g* because it accounts for the single largest component underlying individual differences in mental ability (see Carroll, 1993) and because of the general acknowledgement that psychometric *g* is a strong predictor of academic performance (Hunter, 1986; Jensen, 1984, 1987; Thorndike, 1986).

Previous investigations of the influence of math self-efficacy on math outcomes had not controlled for general mental ability. Instead, researchers used scores from the quantitative section of standardized aptitude tests with samples of college students. This is problematic for two reasons. First, as earlier explained, scores on aptitude tests are confounded by other

attitudinal and anxiety factors related to mathematics. Second, college students' scores on aptitude tests are restricted in range. Because students with lower scores are screened out by the college admission's process, correlations between math performance and aptitude measures in college samples are attenuated. Pajares and Miller (1994a) did not include an ability measure in their path model but acknowledged that its exclusion may have influenced the effects found and recommended that a future model include such a measure with an eye to testing their findings. A nonverbal, untimed measure of general mental abilities such as Raven's Advanced Progressive Matrices is less influenced by educational background than are aptitude tests or other ability measures. Thus, it minimizes the confounding and provides a better control for ability in a path model testing the mediational role of self-efficacy.

The key finding from this study was that the direct effect of self-efficacy on performance was as strong ($\beta = .348$) as was the effect of ability ($\beta = .321$)(see Figure 3). The direct effect of anxiety on performance ($\beta = -.113$) and that of self-efficacy on anxiety ($\beta = -.411$) support previous findings that the influence of anxiety on academic outcomes is minimized when self-efficacy is included in a model and that anxiety is to a great extent a by-product of efficacy perceptions. These are striking results in light of the particularly stringent test of the influence of self-efficacy that inclusion of a general mental ability measure in the path model provides in an investigation of this type (see Thorndike, 1986; Zimmermann, Bandura, & Martinez-Pons, 1992). In addition, self-efficacy partially mediated the effect of ability and math background both on anxiety and performance. The independent variables accounted for 61% of the variability in problem-solving performance, $F(5,323) = 99.1$, $p < .0001$.

Anxiety correlated significantly with problem-solving performance, but results indicated that the influence of anxiety was primarily a result of noncausal covariation due to the effect of self-efficacy. Similar findings have been reported by researchers exploring mathematics and other academic areas (see Alexander & Martray, 1989; Hackett, 1985; Hackett & Betz, 1989; Pajares & Johnson, 1994, 1995; Pajares & Miller, 1994a). It should be noted that Pajares and Kranzler (1994) also assessed math self-concept but dropped it from the analysis after finding multicollinearity with math anxiety. A path analysis model in which anxiety was replaced with

self-concept revealed similar effects in similar proportions. These findings were supported by preliminary results from two studies investigating the physical science and biology self-efficacy of middle school students (Pajares & Brown, 1995).

Increasing the Predictive Power of Self-efficacy

As earlier noted, even self-efficacy researchers have often used generalized, global, or multiple-scale self-efficacy measures to predict academic outcomes. In studies of math self-efficacy, for example, researchers have generally operationalized the construct in terms of individuals' judgments of their capabilities to solve math problems, perform math-related tasks, and succeed in math-related courses--the three subscales of the Mathematics Self-Efficacy Scale created by Betz and Hackett (1983)(see, for example, Hackett & Betz, 1989; Randhawa, Beamer, & Lundberg, 1993).

In line with Bandura's (1986) guidelines regarding specificity and consistency of self-efficacy and performance assessment, Pajares and Miller (1995) observed that these judgments of math capabilities are substantively different. Although they have in common that all are math-related judgments, their predictive value should largely depend on the nature of the criterial tasks with which they are compared. Consequently, students' judgments to solve math problems should be more strongly predictive of their ability to solve those problems than should their confidence to perform other math-related tasks or succeed in math-related courses. Similarly, their judgments to succeed in math-related courses should be more strongly predictive of their choice to enroll in such courses than should their confidence to solve specific problems or perform mathematics tasks. Figure 4 represents the typical method of using multiple-scale math self-efficacy assessments with dependent measures such as solving math problems or choosing math-related majors. The more parsimonious model in Figure 5 more accurately reflects the role of the same self-efficacy assessments in predicting those outcomes.

Pajares and Miller (1995) compared these judgments of capability with two outcome measures: ability to solve the problems on which self-efficacy was assessed and math-relatedness of academic majors. Results confirmed that Bandura's (1986) warnings regarding specificity of self-efficacy and performance assessment are well founded. Students' confidence to solve

mathematics problems was a more powerful predictor of their ability to solve those problems than was their confidence to perform math-related tasks or their confidence to earn A's or B's in math-related courses. Similarly, their confidence to succeed in such courses was more predictive of their choice of majors that required them to take many of the math-related courses on which they expressed that confidence. Although there are different ways of assessing self-efficacy, the more theoretically appropriate and empirically warranted are those in which the self-efficacy measure assesses the same or similar skills required for the performance task.

Recall that researchers have found that even generalized or less closely related indices will correlate significantly with academic outcomes (see Multon et al., 1991). Pajares and Miller (1995) found this phenomenon as well. That is, each subscale, as well as the full-scale, correlated significantly with each outcome. Prediction was enhanced, however, as self-efficacy and performance correspondence more closely matched.

Math Self-efficacy, Self-concept, Anxiety, and Attributions

Pajares and Dixon (1995) are currently completing a study whose primary focus is to examine the interplay between self-efficacy judgments, motivational variables, and mathematical problem-solving with special education, regular, and gifted middle school students mainstreamed in Algebra classes and special education students who are self-contained as a result of more serious disabilities. The motivational variables include self-concept, anxiety, attributions of success and failure, and self-efficacy for self-regulated learning. In addition, cognitive ability, gender, previous mathematics attainments, race/ethnicity, and socioeconomic status are controlled.

Preliminary results suggest that self-efficacy was predictive of mathematical problem-solving capabilities of all students with the exception of the self-contained special education students. Consistent with previous results, most students were generally overconfident about their math abilities, but self-contained students were significantly more overconfident. In addition, these results point out that the self-contained special education students' self-efficacy perceptions were so out of line with their actual competence that they had little awareness of

what they knew and did not know. This poor calibration makes learning very difficult given that a major factor in learning is the ability to self-correct (Pressley, Borkowsky, & Schneider, 1987).

As expected, gifted students had higher performance, self-efficacy, self-concept, and lower anxiety scores and were better calibrated in their judgments of capabilities than either regular or special education students. These results of higher calibration for gifted students support research findings showing that students with higher general mental ability had higher calibration and performance (Pajares & Kranzler, 1994).

Multiple regression results revealed that math self-efficacy was the strongest predictor of performance in a model that controlled for self-concept, anxiety, self-efficacy for self-regulated learning, cognitive ability, semester grades, socioeconomic status, and gender. Path analyses are in the process of being conducted. As regards the relationship between self-efficacy perceptions and attributions of success and failure, preliminary results reveal that high self-efficacy students tended to attribute their success to ability, intelligence, and their usual effort, whereas low self-efficacy students attributed their success to luck and to the fact that problems are easy. As Bandura (1986, 1995) has theorized, high self-efficacy students tended to attribute their failure to not putting forth their usual effort, whereas low self-efficacy students attributed their failure to ability, luck, general intelligence, and difficult problems. More detailed analyses focusing on each of the student subgroups should provide additional insights.

Conclusions

Beyond supporting the hypothesized predictive and mediational role of self-efficacy, results from the investigations of Pajares and his associates show that, as Bandura (1986) theorized, particularized judgments of capability are better predictors of highly related academic performances than more generalized self-referent judgments. That is to say that specific judgments are better predictors of the specific performances on which the judgments are based than are broader, less contextual, less task-specific judgments. How could it be otherwise? This begs a question of practical utility, given that many criterial tasks of interest in the motivational and academic arenas cannot be assessed with the specificity afforded by, say, the solution of mathematics problems.

Although researchers have demonstrated that self-efficacy beliefs are also good predictors of more generalized outcomes such as grades (Bandura, 1993; Meece et al., 1990; Pintrich & Garcia, 1991), choice of academic majors (Hackett & Betz, 1989), and intention to enroll in math-related courses (Lent, Lopez, & Bieschke, 1993), Lent and Hackett (1987) observed that the optimal level of specificity of an efficacy assessment must ultimately depend on the complexity of the performance criteria with which it is compared. Academic outcomes, particularly in investigations of career choices and decisions, are seldom specific in nature, and Lent and Hackett warned that specificity and precision are often purchased at the expense of external validity and practical relevance. And general self-perceptions are useful in their own right--they can provide teachers and counselors with information regarding students' dispositions, and results may be useful in helping to predict outcomes that do not easily lend themselves to microanalytic analysis. Some researchers have also noted the need to explore the generality of self-efficacy beliefs--that is, the extent to which they relate to, or transfer across, different performance tasks or domains (Lent & Hackett, 1987; Multon et al., 1991). Findings from this line of inquiry should help further the generalizability and practical relevance and utility of self-efficacy theory.

Bandura (1984, 1986, in press) noted that knowledge, competence, and various forms of self-knowledge and self-belief act in concert to provide adequate explanations of behavior. Such explanations cannot be had without considering the role that each may play in human decision-making and functioning in a given context. This rich and often complex interplay may create situations in which self-efficacy is neither the most important influence on nor especially predictive of behavior (Schunk, 1991). Moreover, human functioning is such that discordances between beliefs and between belief and action are possible. For example, some students may be highly confident of their academic ability, but, if the outcomes they expect are dismal (a poor job market, strong competition for few jobs), it is doubtful they will behave in concert with their beliefs. Conversely, low self-efficacy may be overcome by valued outcomes and potential rewards. And of course, if individuals lack necessary skills, no amount of self-efficacy will bring

about the desired performance, although increased effort, persistence, and perseverance may lay the foundation for skill improvement and better subsequent performance.

Nonetheless, Bandura (1984) hypothesized that, because individuals' beliefs of personal competence "touch, at least to some extent, most everything they do" (p. 251) and because self-efficacy mediates the effect of other determinants of behavior, when these determinants are controlled, self-efficacy judgments should prove better predictors of choice and direction of behavior. Because human behavior is multiply determined, however, its understanding and explanation require an appreciation of the interplay among the determinants that act as *common mechanisms* of personal agency. Commonality of mechanism, Bandura cautioned, should not be confused with exclusivity of mechanism. Hence one need not fear that perceived self efficacy will "usurp the lion's share of the variance in human conduct" (p. 252).

It seems clear that, to develop more complete understandings of the sources of this variance, researchers with differing theoretical allegiances should engage in greater intertheoretical crosstalk and investigative collaboration using research designs that incorporate the various constructs *operationalized and used in a manner consistent with the construct's theoretical home*. For example, researchers incorporating self-perceptions of capability into studies of self-concept might ensure that self-efficacy is assessed at a level of specificity consistent with the outcome variables under investigation. For their part, self-efficacy researchers would take the same methodological precautions when assessing and using other motivational constructs. In studies requiring the use of self-report instruments, researchers might more accurately assess a construct by using appropriate instruments created by researchers from the construct's theoretical home than by creating their own. Such efforts would be instrumental in identifying the contexts in which certain motivational constructs may be better predictors of human functioning as well as the unique role that each construct plays in the general development of self-regulatory skills. The result would be a clearer and deeper understanding of the nature of the interplay between self-efficacy and its motivational cousins.

References

Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology, 84*, 261-271.

Ashton, P. T., & Webb, R. B. (1986). *Making a difference: Teachers' sense of efficacy and student achievement.* New York: Longman.

Alexander, L., & Martray, C. (1989). The development of an abbreviated version of the Mathematics Anxiety Rating Scale. *Measurement and Evaluation in Counseling and Development, 22,* 143-150.

Atkinson, J. W. (1957). Motivational determinants of risk-taking behavior. *Psychological Review, 64,* 359-372.

Bandura. A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. Psychological Review, 84, 191-215.

Bandura, A. (1978). Reflections on self-efficacy. Advances in Behavioural Research and Therapy, 1, 237-269.

Bandura. A. (1982). Self-efficacy mechanism in human agency. American Psychologist, 37, 122-147.

Bandura, A. (1984). Recycling misconceptions of perceived self-efficacy. Cognitive Therapy and Research, 8, 231-255.

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice Hall.

Bandura, A. (1989). Human agency in social cognitive theory. American Psychologist, 44, 1175-1184.

Bandura, A. (1991). Social cognitive theory of self-regulation. Organizational Behavior and Human Decision Processes, 50, 248-287.

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist, 28*, 117-148.

Bandura, A. (1995). Self-efficacy. In V. S. Ramachaudran (Ed.). *Encyclopedia of Human Behavior* (vol. 4, 71-81). New York: Academic Press.

Bandura, A. (in press). *Self-efficacy: The exercise of control.* New York: Freeman.

Bandura. A., & Jourden, F. J. (1991). Self-regulatory mechanisms governing the motivational effects of goal systems. Journal of Personality and Social Psychology, 60, 941-951.

Bandura, A., & Schunk, D. H. (1981). Cultivating competence, self-efficacy, and intrinsic interest through proximal self-motivation. Journal of Personality and Social Psychology, 41, 586-598.

Berry, J. M. (1987, September). *A self-efficacy model of memory performance.* Paper presented at the meeting of the American Psychological Association, New York.

Betz, N. E., & Hackett, G. (1983). The relationship of mathematics self-efficacy expectations to the selection of science-based college majors. *Journal of Vocational Behavior, 23,* 329-345.

Bores-Rangel, E., Church, A. T., Szendre, D., & Reeves, C. (1990). Self-efficacy in relation to occupational consideration and academic performance in high school equivalency students. *Journal of Counseling Psychology, 37,* 407-418.

Bouffard-Bouchard, T. (1989). Influence of self-efficacy on performance in a cognitive task. *Journal of Social Psychology, 130,* 353-363.

Brown, S. D., Lent, R. D., & Larkin, K. C. (1989). Self-efficacy as a moderator of scholastic aptitude-academic performance relationships. *Journal of Vocational Behavior, 35,* 64-75.

Carroll, J. B. (1993). *Human cognitive abilities: A survey of factor-analytic studies.* New York, NY: Cambridge University Press.

Collins, J. L. (1982, March). *Self-efficacy and ability in achievement behavior.* Paper presented at the meeting of the American Educational Research Association, New York.

Dew, K. M. H., Galassi, J. P., & Galassi, M. D. (1984). Math anxiety: Relations with situational test anxiety, performance, physiological arousal, and math avoidance behavior. *Journal of Counseling Psychology, 31,* 580-583.

Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review, 95,* 256-272.

Eastman, C., & Marzillier, J. S. (1984). Theoretical and methodological difficulties in Bandura's self-efficacy theory. *Cognitive Therapy and Research, 8,* 213-229.

Eccles, J. (1983). Expectancies, values, and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motives: Psychological and sociological approaches* (pp. 75-146). San Francisco: Freeman.

Feather, N. T. (1988). Values, valences, and course enrollment: Testing the role of personal values within an expectancy-valence framework. *Journal of Educational Psychology, 80,* 381-391.

Felson, R. B. (1984). The effect of self-appraisals of ability on academic performance. *Journal of Personality and Social Psychology, 47,* 944-952.

Fincham, F., & Cain, K. (1986). Learned helplessness in humans: A developmental analysis. *Developmental Review, 6,* 138-156.

Garcia, T., & Pintrich, P. R. (1994). Regulating motivation and cognition in the classroom: The role of self-schemas and self-regulatory strategies. In D. Schunk and B. Zimmerman (Eds.), *Self-regulation of learning and performance: Issues and educational applications.* Hillsdale, NJ: Erlbaum.

Gilligan, C. (1982). *In a different voice.* Cambridge, MA: Harvard University Press.

Hackett, G. (1985). The role of mathematics self-efficacy in the choice of math-related majors of college women and men: A path analysis. *Journal of Counseling Psychology, 32,* 47-56.

Hackett, G., & Betz, N. E. (1989). An exploration of the mathematics self-efficacy/mathematics performance correspondence. *Journal for Research in Mathematics Education, 20,* 261-273.

Hunter, J. E. (1986). Cognitive ability, cognitive aptitudes, job knowledge, and job performance. *Journal of Vocational Behavior, 29,* 340-362.

Jensen, A. R. (1984). Test validity: *g* versus the specificity doctrine. *Journal of Social and Biological Structures, 29,* 93-118.

Jensen, A. R. (1987). The *g* beyond factor analysis. In J. C. Conoley, J. A. Glover, & R. R. Ronning (Eds.), *The influence of cognitive psychology on testing and measurement.* Hillsdale, NJ: Erlbaum.

Kazdin, A. E. (1978). Conceptual and assessment issues raised by self-efficacy theory. *Advances in Behavioural Research and Therapy, 1,* 177-185.

Kirsch, I. (1985). Self-efficacy and expectancy: Old wine with new labels. *Journal of Personality and Social Psychology, 49,* 824-830.

Larson, L. M., Piersel, W. C., Imao, A. K., & Allen, S. J. (1990). Significant predictors of problem-solving appraisal. *Journal of counseling Psychology, 37,* 482-490.

Lent, R. W., Brown, S. D., & Larkin, K. C. (1984). Relation of self-efficacy expectations to academic achievement and persistence. *Journal of Counseling Psychology, 31,* 356-362.

Lent, R. W., Brown, S. D., & Larkin, K. C. (1986). Self-efficacy in the prediction of academic performance and perceived career options. *Journal of Counseling Psychology, 33,* 265-269.

Lent, R. W., & Hackett, G. (1987). Career self-efficacy: Empirical status and future directions. *Journal of Vocational Behavior, 30,* 347-382.

Lent, R. W., Lopez, F. G., & Bieschke, K. J. (1993). Predicting mathematics-related choice and success behaviors: Test of an expanded social cognitive model. *Journal of Vocational Behavior, 42,* 223-236.

Locke, E. A., Frederick, E., Lee, C., & Bobko, P. (1984). Effect of self-efficacy, goals, and task strategies on task performance. *Journal of Applied Psychology, 69,* 241-251.

Maddux, J. E., Norton, L. W., & Stoltenberg, C. D. (1986). Self-efficacy expectancy, outcome expectancy, and outcome value: Relative effects on behavioral intentions. *Journal of Personality and Social Psychology, 51,* 783-789.

Maddux, J. E., & Stanley, M. A. (Eds.). (1986). Self-efficacy theory in contemporary psychology [Special issue]. *Journal of Social and Clinical Psychology, 4*(3).

Manning, M. M., & Wright, T. L. (1983). Self-efficacy expectancies, outcome expectancies, and the persistence of pain control in childbirth. *Journal of Personality and Social Psychology, 45,* 421-431.

Marzillier, J. S., & Eastman, C. (1984). Continuing problems with self-efficacy theory: A reply to Bandura. *Cognitive Therapy and Research, 8,* 257-262.

McCarthy, P., Meier, S., & Rinderer, R. (1985). Self-efficacy and writing. College Composition and Communication, 36, 465-471.

McClelland, D. C. (1985). How motives, skills, and values determine what people do. *American Psychologist, 40,* 812-825.

Meece, J. L., Wigfield, A., & Eccles, J. S. (1990). Predictors of math anxiety and its influence on young adolescents' course enrollment and performance in mathematics. *Journal of Educational Psychology, 82,* 60-70.

Meier, S., McCarthy, P. R., & Schmeck, R. R. (1984). Validity of self-efficacy as a predictor of writing performance. *Cognitive Therapy and Research, 8,* 107-120.

Multon, K. D., Brown, S. D., & Lent, R. W. (1991). Relation of self-efficacy beliefs to academic outcomes: A meta-analytic investigation. *Journal of Counseling Psychology, 38,* 30-38.

Nicholls, J. (1984). Achievement motivation: Conceptions of ability, subjective experience, task choice, and performance. *Psychological Review, 91,* 328-346.

Nicholls, J. G. (1990). What is ability and why are we mindful of it? A developmental perspective. In R. Sternberg & J. Kolligian (Eds.). *Competence considered.* New Haven, CT: Yale University Press.

Pajares, F., & Brown, W. (1995). *Self-efficacy beliefs in middle school science.* Unpublished raw data.

Pajares, F., & Dixon, D. (1995). *Mathematics self-efficacy and performance attainments of mainstreamed regular, special education, and gifted students.* Manuscript in preparation

Pajares, F., & Johnson, M. J. (1994). Confidence and competence in writing: The role of self-efficacy, outcome expectancy, and apprehension. *Research in the Teaching of English, 28,*. 316-334.

Pajares, F., & Johnson, M. J. (1995, April). *Role of self-efficacy beliefs in the writing of high school students: A path analysis.* Paper to be presented at the meeting of the American Educational Research Association, San Francisco.

Pajares, F., & Kranzler, J. (1994). Competence and confidence in mathematics: The role of self-efficacy, self-concept, and general mental ability in mathematical problem-solving. *Florida Educational Research Council Research Bulletin, 26*(1/2). Sanibel, FL: Florida Educational Research Council.

Pajares, F., & Miller, M. D. (1994a). The role of self-efficacy and self-concept beliefs in mathematical problem-solving: A path analysis. *Journal of Educational Psychology, 86,* 193-203.

Pajares, F., & Miller, M. D. (1994b). Mathematics self-efficacy and mathematical problem-solving: Implications of using varying forms of assessment. *Florida Educational Research Council Research Bulletin, 26*(1/2). Sanibel, FL: Florida Educational Research Council.

Pajares, F., & Miller, M. D. (1995). Mathematics self-efficacy and mathematics outcomes: The need for specificity of assessment. *Journal of Counseling Psychology, 42*(2).

Paris, S. G., & Oka, E. (1986). Children's reading strategies, metacognition and motivation. *Developmental Review, 6,* 25-36.

Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82,* 33-40.

Pintrich, P. R., & Garcia, T. (1991). Student goal orientation and self-regulation in the college classroom. In M. Maehr & P. R. Pintrich (Eds.), *Advances in motivation and achievement: Goals and self-regulatory processes* (Vol. 7, p. 371-402). Greenwich, CT: JAI Press.

Pintrich, P. R., Marx, R. W., & Boyle, R. A. (1993). Beyond cold conceptual change: The role of motivational beliefs and classroom contextual factors in the process of conceptual change. *Review of Educational Research, 63,* 167-199.

Pokay, P., & Blumenfeld, P. C. (1990). Predicting achievement early and late in the semester: The role of motivation and use of learning strategies. *Journal of Educational Psychology, 82,* 41-50

Pressley, M., Borkowski, J. G., & Schneider, W. (1987). Cognitive strategies: Good strategy users coordinate metacognition and knowledge. In R. Vasta & G. Whitehurst (Eds.), *Annals of Child Development* (Vol. 5, pp. 89-129). New York: JAI Press.

Randhawa, B. S., Beamer, J. E., & Lundberg, I. (1993). Role of mathematics self-efficacy in the structural model of mathematics achievement. *Journal of Educational Psychology, 85,* 41-48.

Relich, J. D., Debus, R. L., & Walker, R. (1986). The mediating role of attribution and self-efficacy variables for treatment effects on achievement outcomes. *Contemporary Educational Psychology, 11,* 195-216.

Rosenberg, M., & Kapland, H. B. (1982). *Social psychology of the self-concept.* Arlington Heights, IL: Harlan Davidson.

Schunk, D. H. (1981). Modeling and attributional effects on children's achievement: A self-efficacy analysis. *Journal of Educational Psychology, 73,* 93-105.

Schunk, D. H. (1982a). Effects of effort attributional feedback on children's perceived self-efficacy and achievement. *Journal of Educational Psychology, 74,* 548-556.

Schunk, D. H. (1982b). Verbal self-regulation as a facilitator of children's achievement and self-efficacy. *Human Learning, 1,* 265-277

Schunk, D. H. (1983). Developing children's self-efficacy and skills: The roles of social comparative information and goal setting. *Contemporary Educational Psychology, 8,* 76-86

Schunk, D. H. (1984). Self-efficacy perspective on achievement behavior. *Educational Psychologist, 19,* 48-58.

Schunk, D. H. (1985). Self-efficacy and classroom learning. *Psychology in the Schools, 22,* 208-223.

Schunk, D. H. (1987). Peer models and children's behavioral change. *Review of Educational Research, 57,* 149-174.

Schunk, D. H. (1989). Self-efficacy and achievement behaviors. *Educational Psychology Review, 1,* 173-208.

Schunk, D. H. (1991). Self-efficacy and academic motivation. *Educational Psychologist, 26,* 207-231.

Schunk, D. H., & Cox, P. D. (1986). Strategy training and attributional feedback with learning disabled students. *Journal of Educational Psychology, 78,* 201-209.

Schunk, D. H., & Gunn, T. P. (1985). Modeled importance of task strategies and achievement beliefs: Effects on self-efficacy and skill development. *Journal of Early Adolescence, 5,* 247-258.

Schunk, D. H., & Gunn, T. P. (1986). Self-efficacy and skill development: Influence of task strategies and attributions. *Journal of Educational Research, 79,* 238-244.

Schunk, D. H., & Hanson, A. R. (1985). Peer models: Influence on children's self-efficacy and achievement. *Journal of Educational Psychology, 77,* 313-322.

Schunk, D. H., & Hanson, A. R. (1988). Influence of peer-model attributes on children's beliefs and learning. *Journal of Educational Psychology, 81,* 431-434.

Schunk, D. H., & Rice, J. M. (1993). Strategy fading and progress feedback: Effects on self-efficacy and comprehension among students receiving remedial reading services. *Journal of Special Education, 27,* 257-276.

Shavelson, R. J., & Bolus, R. (1982). Self-concept: The interplay of theory and models. *Journal of Educational Psychology, 74,* 3-17.

Shavelson, R. J., Hubner, J. J., & Stanton, G. C. (1976). Self-concept: Validation of construct interpretations. *Review of Educational Research, 46,* 407-441.

Shell, D. F., Murphy, C. C., & Bruning, R. H. (1989). Self-efficacy and outcome expectancy mechanisms in reading and writing achievement. *Journal of Educational Psychology, 81,* 91-100.

Smith, R. J., Arnkoff, D. B., & Wright, T. L. (1990). Test anxiety and academic competence: A comparison of alternative models. *Journal of Counseling Psychology, 37,* 313-321.

Teasdale, J. D. (1978). Self-efficacy: Toward a unifying theory of behavioural change. *Advances in Behavioural Research and Therapy, 1,* 211-215.

Thorndike, R. L. (1986). The role of general ability in prediction. *Journal of Vocational Behavior, 29,* 332-329.

Valiante, G., & Pajares, F. (1995). *Predictive utility, causal influence, and root causes of the writing self-efficacy beliefs of upper elementary students.* Manuscript in preparation.

Vollmer, F. (1986a). The relationship between expectancy and academic achievement: How can it be explained? *British Journal of Educational Psychology, 56,* 64-74.

Weiner, B. (1979). A theory of motivation for some classroom experiences. *Journal of Educational Psychology, 71,* 3-25.

Wigfield, A., & Eccles, J. (1992). The development of achievement task values: A theoretical analysis. *Developmental review, 12,* 265-310.

Wilhite, S. C. (1990). Self-efficacy, locus of control, self-assessment of memory ability, and study activities as predictors of college course achievement. *Journal of Educational Psychology, 82,* 696-700.

Wood, R. E., & Bandura, A. (1989). Impact of conceptions of ability on self-regulatory mechanisms and complex decision making. *Journal of Personality and Social Psychology, 56,* 407-415.

Wood, R. E., & Locke, E. A. (1987). The relation of self-efficacy and grade goals to academic performance. *Educational and Psychological Measurement, 47,* 1013-1024.

Zimmerman, B. J., & Bandura, A. (1994). Impact of self-regulatory influences on writing course attainment. *American Educational Research Journal, 31,* 845-862.

Zimmerman, B. J., Bandura, A., & Martinez-Pons, M. (1992). Self-motivation for academic attainment: The role of self-efficacy beliefs and personal goal setting. *American Educational Research Journal, 29,* 663-676.

Zimmerman, B., & Ringle, J. (1981). Effects of model persistence and statement of confidence on children's self-efficacy and problem-solving. *Journal of Educational Psychology, 73,* 485-493.

Table 1.

Means, Standard Deviations, and Zero-order Correlations of Variables in the Path Analysis (Pajares & Miller, 1994a)

Variable	M	SD	GENDER	HSL	CC	USE	MSC	MAS	MSE
HSL	4.9	1.2	.11*						
CC	10.3	6.0	-.07	.15**					
USE	50.9	15.2	.05	.12*	.06				
MSC	49.7	16.6	.13*	.48***	.25***	.40***			
MAS	31.8	10.9	.15**	.44***	.20***	.32***	.87***		
MSE	73.6	10.5	.24***	.47***	.23***	.19***	.61***	.56***	
PERF	14.1	2.8	.17***	.44***	.23***	.14**	.54***	.51***	.70***

HSL = High school level; CC = College credits earned; MSE = Math self-efficacy; MSC = Math self-concept; MAS = Math anxiety; USE = Perceived usefulness of mathematics; PERF = Math problem-solving performance.

* $p < .05$ ** $p < .01$ *** $p < .001$

Figure 1. *Path model representing significant path coefficients between variables predicting mathematics problem-solving (Pajares & Miller, 1994a).*

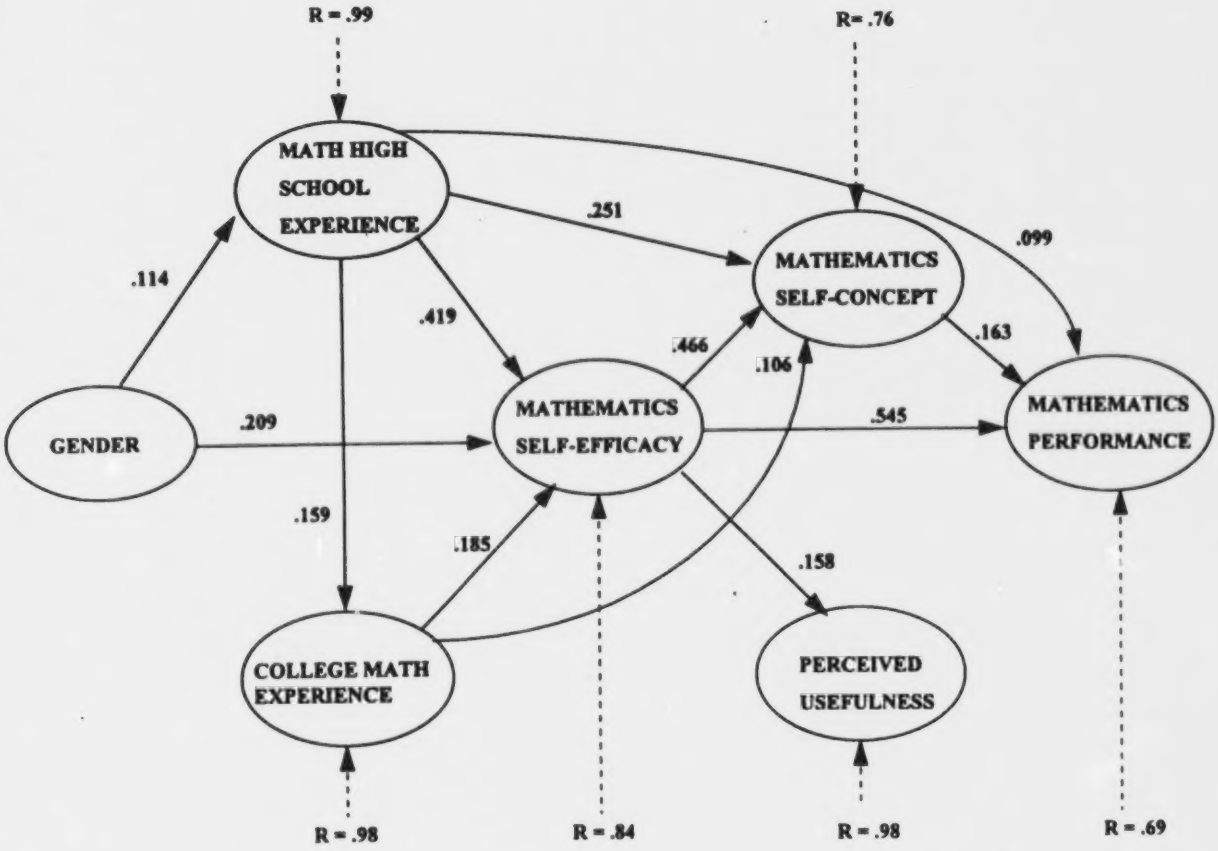

Table 2.

Zero-order Correlations Between Variables in the Study (Pajares & Johnson, 1995)

	M	SD	1	2	3	4	5	6	7	8
1. GENDER	--	--	--							
2. ETHNIC BACKGROUND	--	--	.04	--						
3. AGE	14.6	0.59	.00	-.05	--					
4. APTITUDE	2.5	0.92	-.13	.37***	-.14	--				
5. APPREHENSION	60.4	12.74	.13	-.22**	.16*	-.37***	--			
6. SELF-CONCEPT	49.2	13.54	-.25**	.22*	-.22**	.38***	-.88***	--		
7. SELF-EFFICACY	75.9	20.27	.09	.39***	-.27**	.41***	-.47***	.51***	--	
8. PERFORMANCE	3.7	1.08	-.00	.43***	-.27**	.60***	-.48***	.47***	.60***	--

* $P < .05$. ** $P < .001$. *** $P < .0001$

Note. 1. For GENDER, girls were coded 0; boys were coded 1.

2. For ETHNIC BACKGROUND, Hispanic students were coded 0; non-Hispanic White students were coded 1. African American or Asian American students were not included in this analysis.

Figure 2. *Path model representing significant path coefficients between variables predicting essay-writing performance (Pajares & Johnson, 1995).*

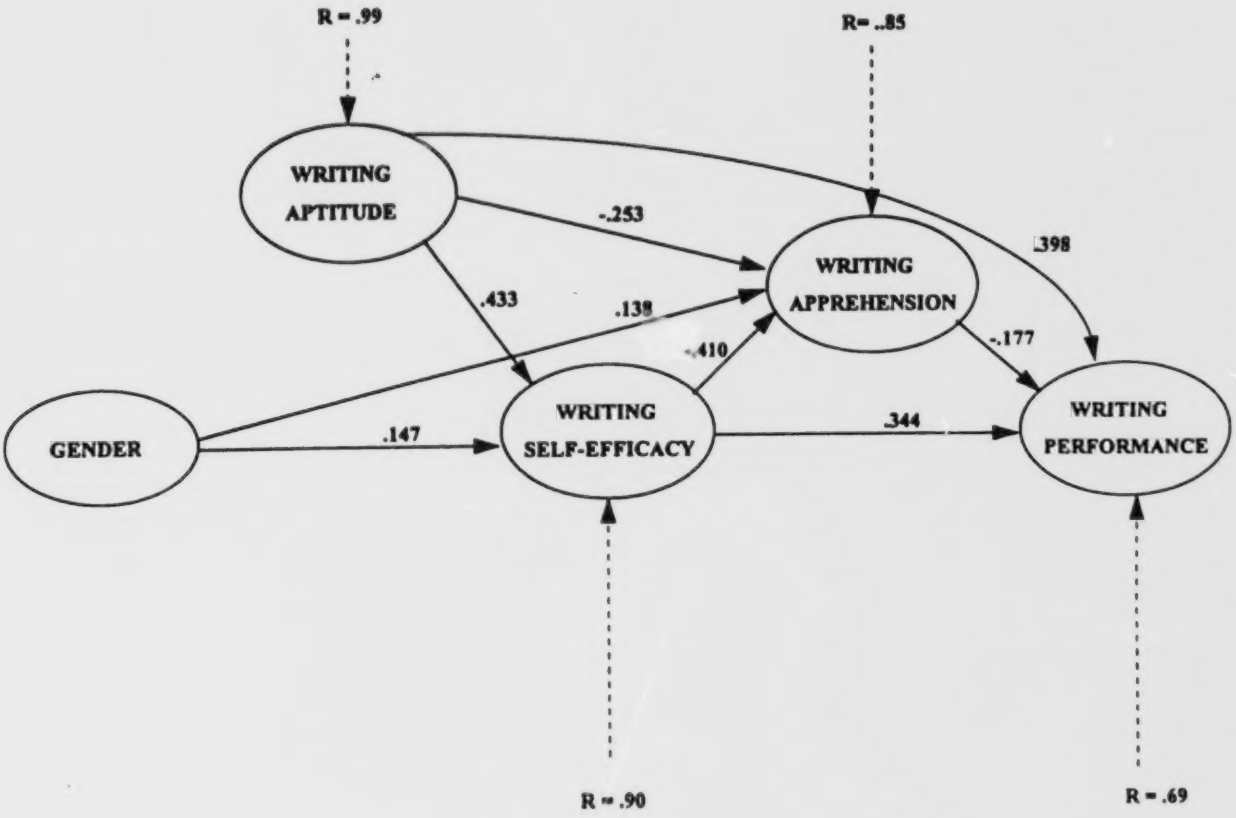

Table 3.

Means, Standard Deviations, and Zero-order Correlations for Variables in the Study (Pajares & Kranzler, 1994).

Variable	M	SD	1	2	3	4	5	6	7	8
1. GENDER	--	--	--							
2. RACE	--	--	.02	--						
3. RAVEN	19.0	5.9	.04	.31***	--					
4. HSL	5.0	1.4	-.03	.15**	.40***	--				
5. MAS	25.8	8.7	-.28***	-.12*	-.43***	-.16**	--			
6. MSC	52.3	13.8	.27***	.12*	.41***	.27***	-.81***	--		
7. MSE	81.5	16.3	.10	.21**	.48***	.35***	-.53***	.55***	--	
8. PERF	9.4	4.3	.02	.33***	.63***	.52***	-.46***	.49***	.64***	--
9. CAL	11.2	3.1	.04	.25***	.42***	.38***	-.26***	.31***	.17**	.67***

Note: RAVEN = General Mental Ability; HSL = High school level; MSE = Math self-efficacy; MAS = Math anxiety; MSC = Math self-concept; PERF = Math problem-solving performance; CAL = Calibration score

* $p < .05$. ** $p < .001$. *** $p < .0001$. N = 329

Figure 3. *Path model representing significant path coefficients between variables predicting mathematics problem-solving (Pajares & Kranzler, 1994).*

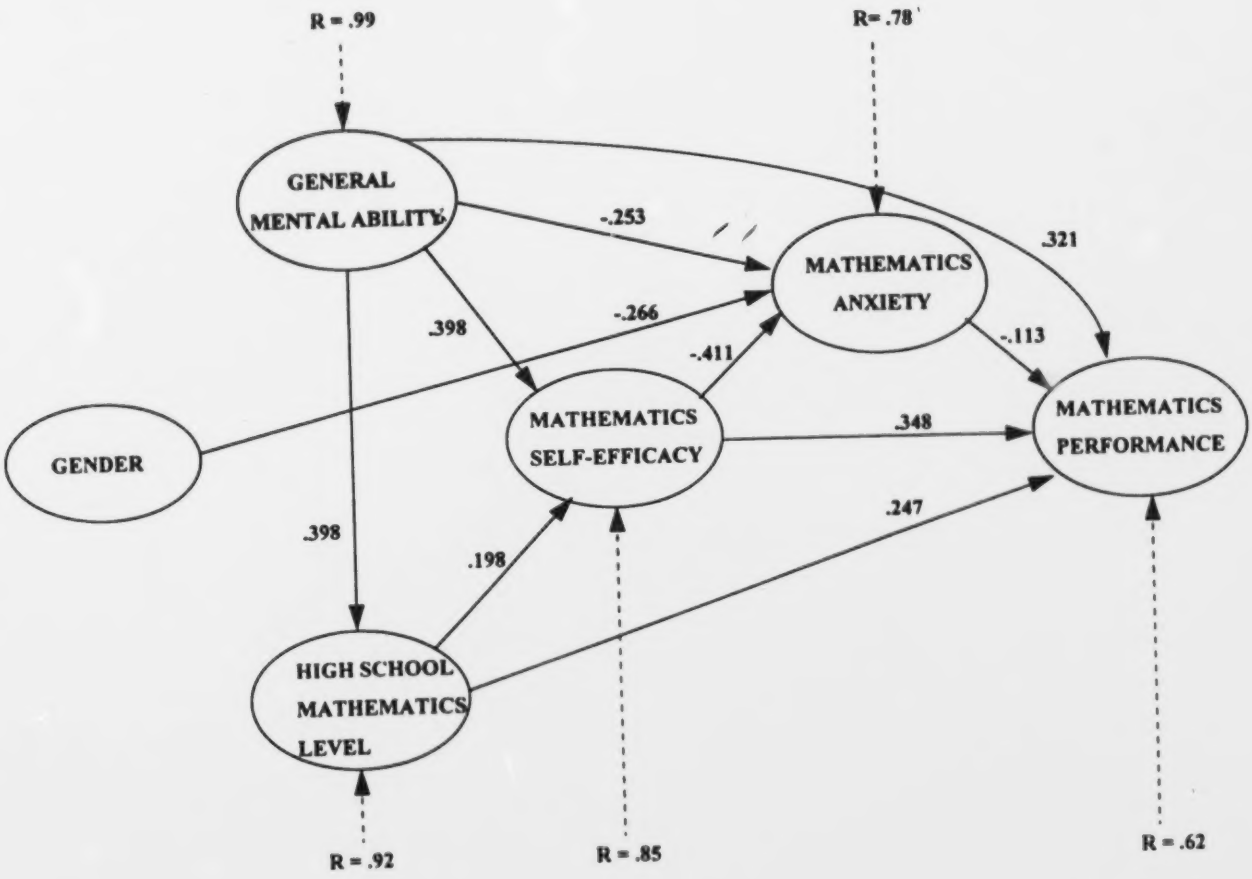

Figure 4. *Multiple mathematics self-efficacy assessments to predict solving math problems and selecting math-related majors (Pajares & Miller, 1995)*

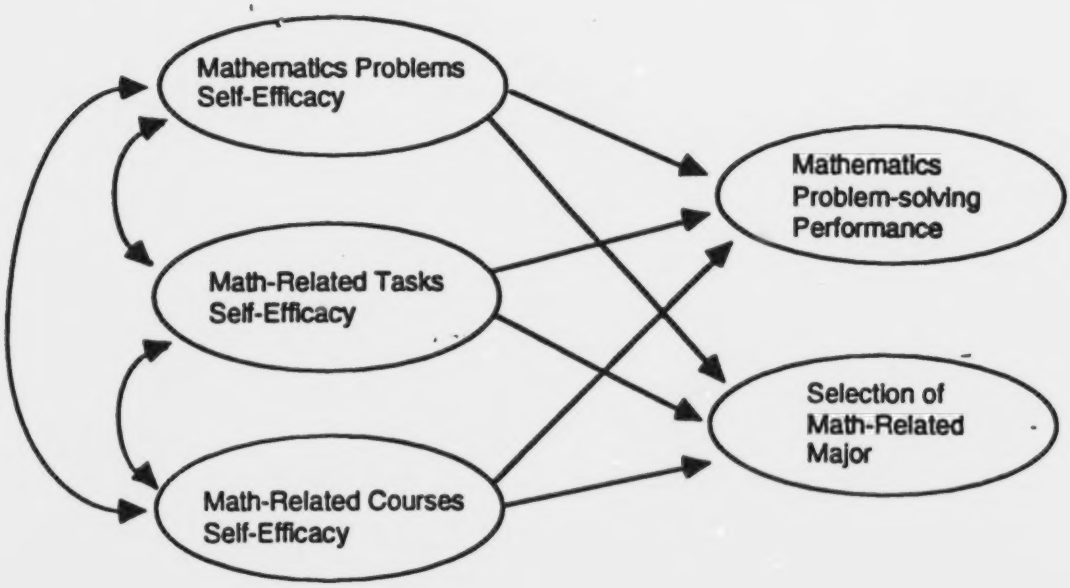

Figure 5. *Mathematics self-efficacy assessment matched to related outcomes.*